Barriers to CHP

CHP Summit
December 1, 1998

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MARKET for CHP

- FROM MY EXPERIENCE, CHP IS BEST SUITED FOR MEDIUM TO LARGE INSTITUTIONS and INDUSTRIAL PROCESS PLANTS
- TYPICALLY THOSE FACILITIES WITH 4 to 20 MW POWER USAGE and 20 to 250 KLB/HR STEAM USE
- IT IS CRITICAL TO MATCH THE THERMAL and POWER LOAD PROFILE OF THE USER WITH THE PROPOSED CHP SYSTEM
- SUCCESSFUL PROJECTS MUST HAVE AN INTERNAL ADVOCATE OF CHP

INSTITUTIONAL / OWNER BARRIERS TO CHP

- THERE IS NOT AN INDUSTRY WIDE ACCEPTANCE OF CHP
- UNCERTAINITY OF UTILITY RATE PROJECTIONS
- SIMPLE PAYBACK IS GREATER THAN 3 YEARS (PARTICULIARY A PROBLEM WITH PUBLIC COMPANIES)
- CHP SYSTEMS ARE MORE COMPLEX, REQUIRE AN EDUCATED OWNER
- CREDIBILITY OF COMPANIES PROMOTING CHP
- IN GENERAL, AN OWNERS INABILITY TO GET A WARM FUZZY FEELING ABOUT NEW CONCEPTS

PROJECT BARRIERS TO CHP

- THE LOAD PROFILE OF THE USER DOES NOT MATCH THE PROPOSED CHP LOAD PROFILE
- CHP IS SUITED FOR CONTINOUS LARGE UTILITY USERS
  - PROCESSES THAT OPERATE 24 HRS/DAY, 7 DAYS WEEK
  - CHP DOES NOT OPERATE WELL AT PART LOAD
- UTILITY INTERVENTION (PROJECT BUYOUT, STALLING, ETC.)
- STATE UTILITY FUNDING IS BASED ON ACTUAL EXPENDITURES. NO UTILITY SAVINGS ACCRUE TO THE INSTITUTION; ie NO INCENTIVE TO RISK NEW TECH.

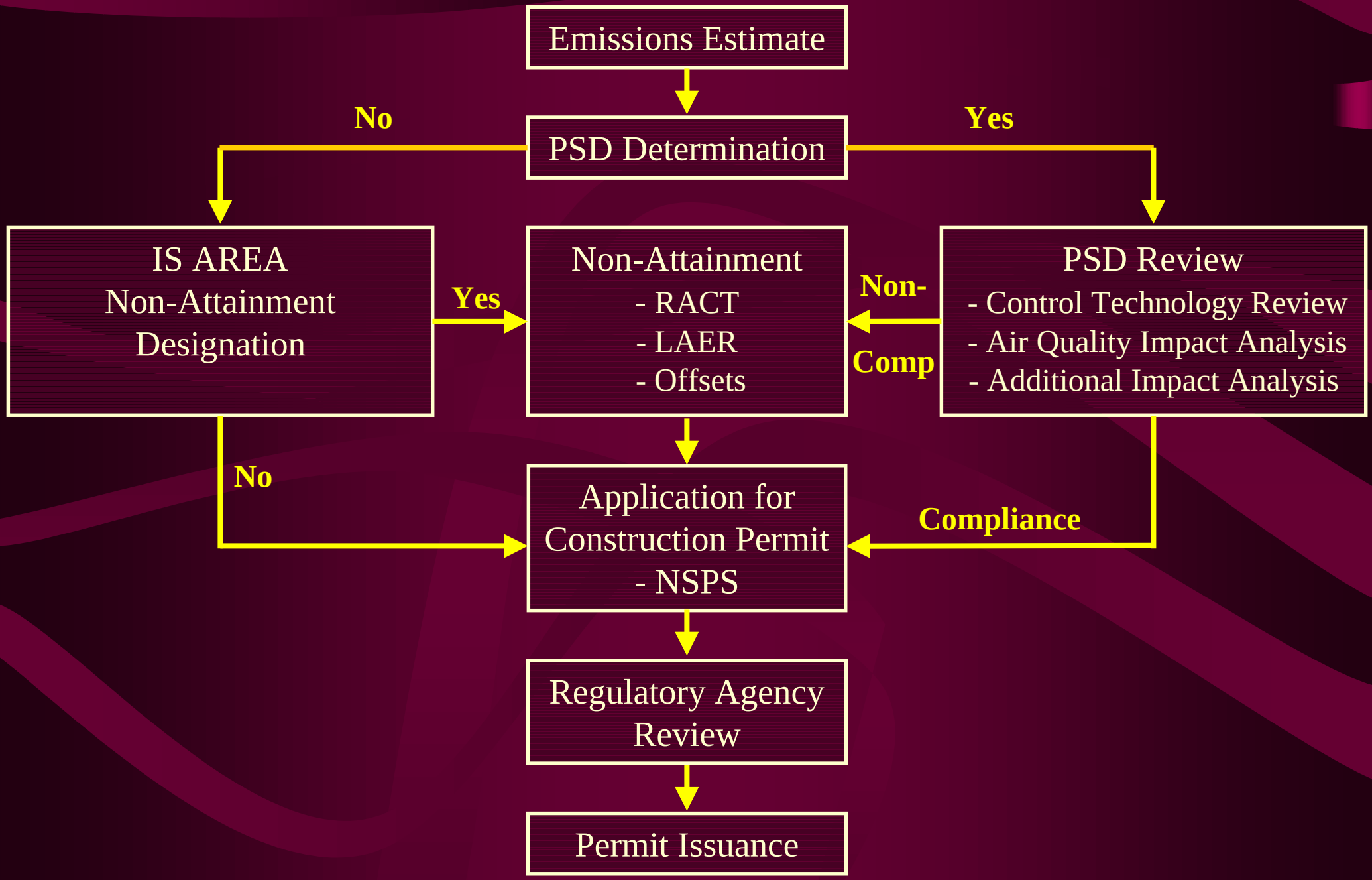
UTILITY INTERCONNECTS

- TECHNICALLY INTERCONNECTS WITH UTILITY SYSTEMS ARE A SOLVABLE PROBLEM; HOWEVER ,
  - EACH ONE IS UNIQUE
  - OWNER NEEDS A FULL UNDERSTANDING OF UTILITY REGULATIONS :
    - FAULT , VOLTAGE, HARMONIC ANALYSIS
    - TRIPPING AND RECLOSE REQUIREMENTS
    - PARALLEL/STAND ALONE OPERATION
- INTERCONNECTS ARE DRIVEN BY UTILITY STANDARDS AN ARE MORE COMPLICATED AND EXPENSIVE THAN NECESSARY
- A BIGGER OBSTACLE IS THE UTILITIES EXCLUSIVE FRANCHISE TO DISTRIBUTE POWER
- ALL OF THE ABOVE ITEMS IMPACT THE TECHNICAL FEASABILITY AND LCC OF CHP PROJECTS

ENVIRONMENTAL PERMITTING CONSIDERATIONS

- CHP PROJECTS GENERATE TWO (2) NON-ENERGY EFFLUENT STREAMS FOR WHICH ENVIRONMENTAL PERMITTING MUST BE CONSIDERED, AIR EMISSIONS AND WATER.
- THE PERMITTING REQUIREMENTS FOR EFFLUENT WATER ARE EASILY OVERCOME WITH TECHNICAL SOLUTIONS, AND HAVE NOT POSED PROBLEMS IN THE PAST.
- THE PERMITTING REQUIREMENTS FOR AIR EMISSIONS ARE AT A MINIMUM FEDERALLY REGULATED AND CAN BE COMPLICATED, COSTLY, AND TIME CONSUMING.

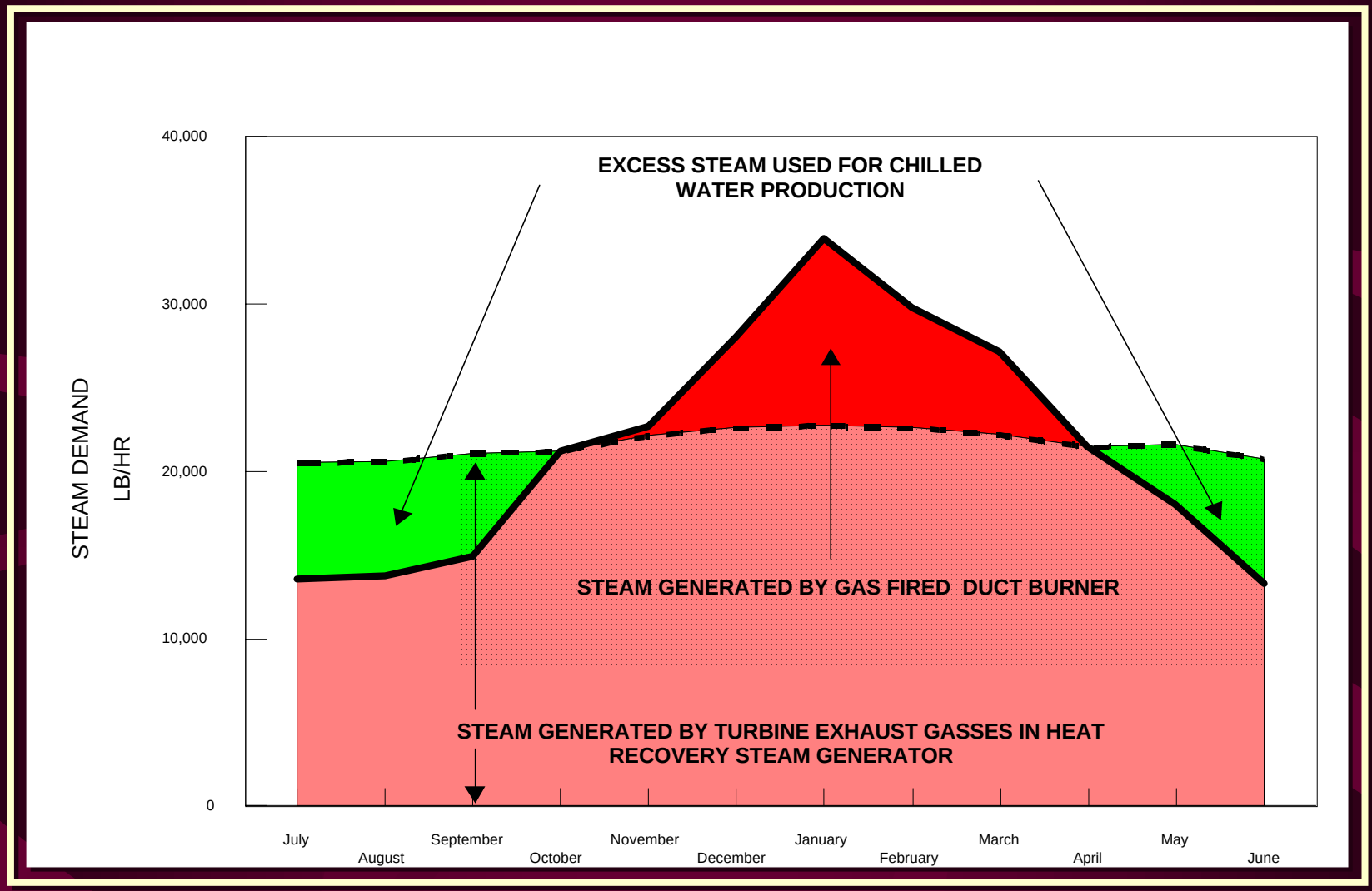
AIR PERMITTING PROCESS



SUCCESSFUL CHP INSTALLATION OPRYLAND HOTEL

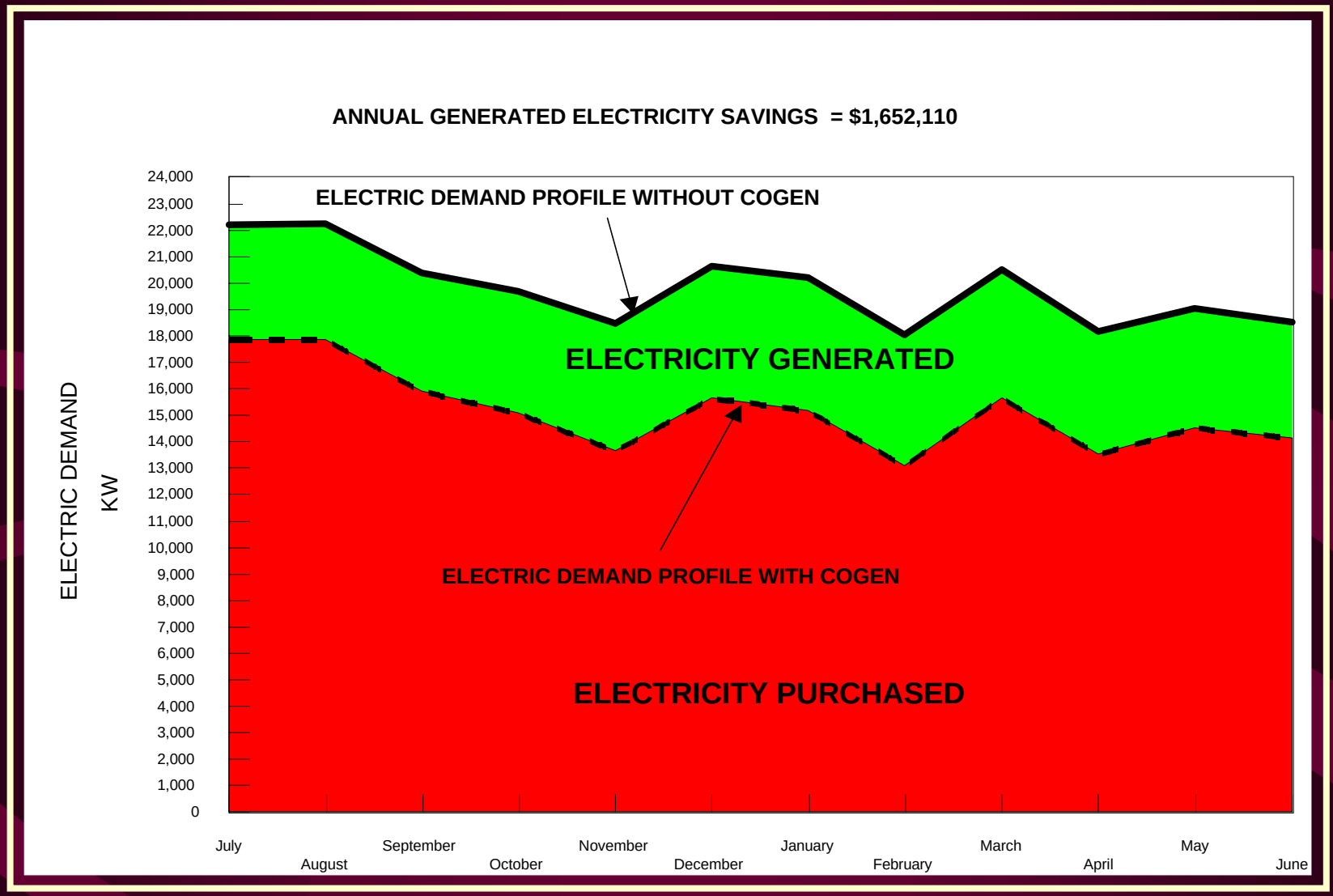
- THE OPRYLAND COMPLEX :
  - 3,000 ROOMS
  - 600,000 SQ. FT. of CONVENTION SPACE
  - 7+ ACRES of ENCLOSED ATRIUM

FACILITY THERMAL LOAD PROFILE



- MATCHING THERMAL LOAD CRITICAL TO LCC

FACILITY POWER LOAD PROFILE



- CHP DISPLACES PURCHASED POWER ONLY

GAS TURBINE GENERATOR

- THE HEART OF THE SYSTEM
- NOMINAL 5 MW GAS TURBINE WITH INLET AIR COOLING

HEAT RECOVERY STEAM GENERATOR

- HSRG, 80,000 LB/HR @ 125 PSIG
- 97 % EFFICIENT IN TEG MODE

SWITCH GEAR

- ELECTRIC DISTRIBUTION MODIFIED TO A SINGLE POINT METER SYSTEM
- HUGE COST, COULD BE AVOIDED WITH LOAD AGGREGATION

CHILLED WATER PLANT

- 9,000 TON CAPACITY
- 1,000 TON, 2 STAGE CHILLER
  USED FOR EXCESS FREE STEAM

CONCLUSION

- MORE OPPORTUNITY FOR CHP DEVELOPMENT IN THIS COUNTRY THAN ANY OTHER ENERGY EFFICIENCY IMPROVEMENTS
- CHP IS IDEAL AS A BASIS OF ANY NEW POWERHOUSE DESIGN OR WHEN INTEGRATED INTO AN EXISTING POWERHOUSE